PATENT SPECIFICATION (11) 1 601 667

1 601 667

(21) Application No. 23851/78 (22) Filed 30 May 1978

(31) Convention Application No. 667/78 (32) Filed 23 Jan. 1978 in

(33) Switzerland (CH)

(44) Complete Specification published 4 Nov. 1981

(51) INT. CL.³ F28F 9/22

(52) Index at acceptance F4S 5E3

(54) IMPROVED FLOW GUIDING IN TUBE BUNDLE HEAT EXCHANGERS

(71) I, RENE GOSSALTER, of Postfach 715, 9001 St. Gallen, Switzerland, of Swiss nationality, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a guiding device for flow guide means in shell and tube bundle heat exchangers.

Th invention makes possible the improvement in the heat transfer at a low pressure drop and the simple threading of the individual tubes in mounting the tube bundle apparatus.

Without the guiding device, the media flows on the exterior of the tube bundle apparatus along the tubes. Without any flow guiding device, the velocity distribution is distributed non-uniformly over the outer surface so that, in relationship to the pressure loss, lower heat transfer figures are produced.

As is known, the heat transfer increases less than proportionally to the velocity, whilst the pressure loss increases considerably more than proportionally, practically quadratically.

Furthermore it is known that the heat transfer when the tubes are subject to cross flow is considerably increased with respect to the heat transfer which can be achieved with longitudinal flow.

Guide means for providing a better distribution of the flow velocity and, above all, for providing partial cross flow, are known in the form of so called fittings.

However, the guide means known up till now have considerable deficiencies. They provide a low heat transfer yield but a disproportionately high pressure loss.

In addition, there exist with the known guide means, zones of low flow velocity in which the danger of deposit formations is increased.

Among other things, segmented circular discs are known which are mounted in the external space transverse to the axes and at uniform distances from one another and with the edges of the segments against one another.

These guide means force the medium to flow to and fro in the external space thus, in part transversely with respect to the tubes, whereby the medium flows round the edges of the segments at more or less 180°. This enforced change in direction of 180° produces very non-uniform velocity distributions and partial longitudinal flows in the external space so that an improvement in the heat transfer corresponding to the pressure loss cannot be achieved.

Moreover, so called disc fittings are known in the capacity of guiding means. Normally, these discs have a circular opening in the centre so that the flow can pass through and at an axial distance therefrom a baffle plate of larger diameter than the central opening in the preceding disc.

With the disc guiding means, the medium flowing in the external space is also only partially guided transversely with respect to the fitted tubes and the changes in direction of 180° worsen the ratio of the heat transfer to the pressure loss in the same manner as with the segmented means.

As opposed to the previously known arrangements, a flow guiding means in accordance with the invention enables a substantially uniform helical flow with a uniform transverse flow over the tubes.

In accordance with the invention there is provided flow guide means for guiding the flow in the external-fluid space of a shell and tube-bundle heat-exchanger, comprising a series of sector-shaped flow guide elements provided with apertures through which a plurality of the tubes extend and arranged one after the other in spaced apart relation in the axial direction of the tube bundle, each said element having a central angle equal to or smaller than 180° and each being rotated relatively to the next through an angle approximately equal to said central angle, the arrangement forming a spiral staircase type guide for the medium flowing in said space, the arcuate edges of said elements abutting the inner surface of the shell enclosing said space so that flow between

the elements and the shell is prevented.

The flow cross section which is available to the medium is varied by changing the level of the spacing supports. In this manner, the flow velocity in the external space can be varied as desired.

Flow guiding means according to the invention produce a uniform transverse flow, without a rapid and repeated change in the direction of flow.

With the flow guiding means in accordance with the invention there are no zones of considerably reduced velocity.

Flow means according to the invention provide considerable advantages over the previously known guide means.

The velocity is uniformly distributed over the flow path and the heat transfer is substantially greater with the same pressure loss.

The danger of deposits forming is very greatly reduced.

By increasing or reducing the spacing of the circular sector discs along the flow path, the changes in volume of the medium flowing through the external space of the tube bundle apparatus, can be so balanced that the flow velocity is maintained at the value most desirable for the heat transfer.

When using the invention in the assembly of condensors or evaporators, the average heat transfer, for example, can be substantially increased with condensors.

An embodiment of a flow guide means according to the invention is illustrated by way of example in Figures 1 to 4 of the drawings.

In Figure 1, a view of a circular sector disc is illustrated with a sector angle of 60°.

Figure 2 illustrates a spacing support for maintaining the circular sector discs at an appropriate spacing.

Figure 3 represents a cross section through a tube bundle apparatus transverse to the axis in which, for the sake of better visibility only three circular sector discs, have been drawn.

Figure 4 shows a section on the section line E-E illustrated in Figure 3.

The three circular sector discs (or sector-shaped flow guide elements) illustrated in Figure 3 have the references 1, 2 and 3 wherein the circular sector disc 2 is higher than the circular sector disc 1 by a distance determined by the spacing supports 4.

The circular sector disc 3 is likewise at same distance higher than the circular sector disc 2.

The higher mounting of the next circular sector disc rotated through 60° is repeated throughout the entire length of the flow guiding means.

The circular sector disc 3 according to Figure 1 has three bores 16 for the passage of the tubes 5 and bores 14 into which the pins 15 on the spacing supports 4 are pressed.

In Figure 3, the spacing supports 4, which are forced into the circular sector disc 3, are shown located either contiguous with adjacent tubes 5 or contiguous with the casing (or shell) 6 and an adjacent tube 5.on one side. Thus, it is apparent that the spacing supports cover the space between the tubes 5 and between the tubes 5 and the casing 6, so that the medium is forced to follow the spiral staircase like arrangement of the circular sector discs.

The spacing supports between the circular sector discs can be so arranged that they cover the free space between the tubes and the circular sector discs from stage to stage at the level of the stages so that the medium is forced to flow through the external space helically.

WHAT I CLAIM IS:—

1. Flow guide means for guiding the flow in the external-fluid space of a shell and tube-bundle heat-exchanger, comprising a series of sector-shaped flow guide elements provided with apertures through which a plurality of the tubes extend and arranged one after the other in spaced apart relation in the axial direction of the tube bundle, each said element having a central angle equal to or smaller than 180° and each being rotated relatively to the next through an angle approximately equal to said central angle, the arrangement forming a spiral staircase type guide for the medium flowing in said space, the arcuate edges of said elements abutting the inner surface of the shell enclosing said space so that flow between the elements and the shell is prevented.

2. Flow guide means according to claim 1 characterised in that spacing supports are located between said elements and so arranged and dimensioned as to be contiguous either with adjacent tubes or with the shell and an adjacent tube.

3. Flow guide means according to claim 1 or 2 characterised in that the distances between the flow guide elements along the flow path are smaller or greater.

4. Flow guide means for guiding the flow in the external-fluid space of a shell and tube-bundle heat-exchanger, constructed and arranged substantially as herein

described with reference to the accompanying drawings.

5. A shell and tube bundle heat exchanger comprising flow guide means according to any preceding claim.

A. A. THORNTON & CO.,
Chartered Patent Agents,
Northumberland House,
303-306 High Holborn,
London, W.C.1.

Printed for Her Majesty's Stationery Office by The Tweeddale Press Ltd., Berwick-upon-Tweed, 1981. Published at the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1601667 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

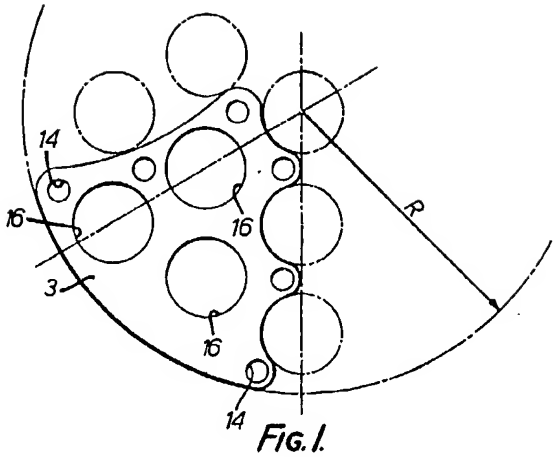

FIG. 1.

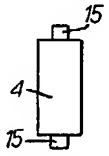

FIG. 2.

1601667 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 2

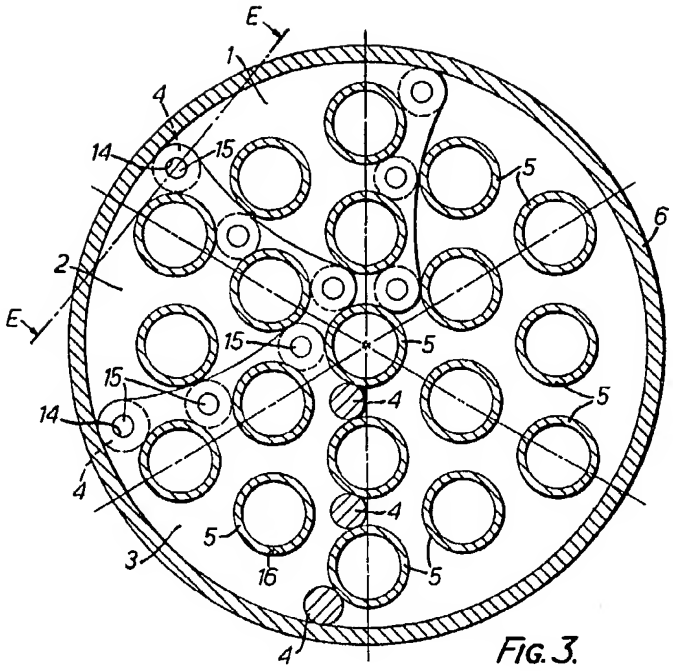

FIG. 3.

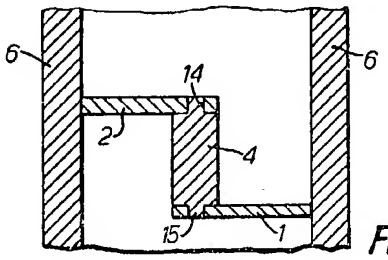

FIG. 4.